Optical Character Recognition (OCR) Family Card Image Using YOLO and PaddleOCR for Automated Data Entry Solution

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ABSTRACT

The digitization of administrative documents, such as Family Cards, is essential for enhancing efficiency and accuracy in government data entry processes. However, traditional Optical Character Recognition (OCR) systems often struggle with distorted layouts, handwritten text, and noisy images. This paper presents a novel approach to automating Family Card data entry using a hybrid solution that integrates YOLO for object detection and PaddleOCR for text recognition.The proposed system consists of a web-based application developed using Flask, featuring an intuitive user interface for uploading Family Card images and extracting structured data. The backend workflow leverages YOLO to detect regions of interest, while PaddleOCR performs advanced text extraction and recognition. The system also includes data cleaning and formatting steps to ensure consistency and accuracy. The extracted information, such as the head of the family's name, address, and household details, is presented on the web interface for user verification and editing.Experimental results demonstrate the efficiency of this approach, significantly improving the accuracy and reliability of data extraction compared to conventional OCR systems. This automated solution not only reduces manual effort but also minimizes human error, making it highly suitable for large-scale government applications and other data-intensive industries.

Keywords: *Optical Character Recognition, YOLO, PaddleOCR, Family Card, Data Entry Automation, Flask Application, Government Document Processing*

I. INTRODUCTION

Data entry is a critical process in many organizations, particularly in sectors that require handling large volumes of personal information such as government agencies, financial institutions, and healthcare providers. Despite advancements in technology, many organizations still rely on manual, paper-based data entry methods. This approach is not only time-consuming and labor-intensive but also prone to human error, which can lead to inaccuracies and inefficiencies (Smith, 2020; Johnson, 2021).

One specific area where these inefficiencies are evident is in the handling of Family Cards (Kartu Keluarga) in Indonesia. These documents contain vital information about family members, and accurate data entry is crucial for various administrative purposes. However, the current manual entry process is fraught with challenges. This situation calls for an efficient solution that can streamline the data entry process, reduce errors, and save time (Putra, 2020; Rahman, 2021).

Optical Character Recognition (OCR) is a technology that identifies and recognizes text within scanned documents, photos, or images. OCR technology powers tools that can extract data from PDFs or scanned documents by converting it into machine-readable text/data that can be edited, displayed, searched electronically, and stored more conveniently for further processing. Over the years, OCR has been increasingly adopted in many document-processing workflows that previously depended on manual data entry. OCR is used to extract data from all types of documents and send it to other business applications for further processing (Zelic & Sable, 2023).

By integrating OCR technology into the handling of Family Cards, we can significantly enhance the efficiency and accuracy of data entry processes. OCR technology allows automated recognition and digitization of text from scanned documents, reducing manual input and minimizing human error. This solution not only addresses the immediate challenges but also sets the foundation for more advanced data management and processing capabilities in the future, such as integration with national databases and predictive analytics for public service improvements (Santoso, 2020; Dewi & Haryanto, 2022).

II. THEORITICAL FRAMEWORK

1.1. Optical Character Recognition (OCR)

OCR, or Optical Character Recognition, is a technology that identifies and recognizes text within scanned documents, photos, or images. OCR technology powers tools that can extract data from PDFs or scanned documents by converting it into machine-readable text or data that can be edited, displayed, searched electronically, and stored more conveniently for further processing. Over the years, OCR has been increasingly adopted in many document-processing workflows that previously depended on manual data entry. OCR is used to extract data from all types of documents and send it to other business applications for further processing. Here's a deep dive into how optical character recognition works. Fig. 1 shows the OCR process (Smith & Johnson, 2020; Patel, 2021).

Figure 1. OCR Process

OCR as a process generally consists of several sub-processes to perform as accurately as possible. The subprocesses are:

- Preprocessing of the Image
- Text Localization
- Character Segmentation
- Character Recognition
- Post Processing

The sub-processes in the list above of course can differ, but these are roughly steps needed to approach automatic character recognition. In OCR software, it’s main aim to identify and capture all the unique words using different languages from written text characters (Zelic & Sable, 2023).

Optical Character Recognition (OCR) technology has a long and interesting history. It originated in the early 20th century with the development of technologies designed to aid the visually impaired by converting printed text into telegraphy signals. Over the decades, OCR technology has evolved significantly, with major milestones including:

1) 1929: Gustav Tauschek obtained a patent on OCR in Germany (Fischer, 2020).
2) 1950s: The first commercial OCR systems were developed, capable of reading specific typefaces (Mori et al., 1992).

3) 1970s: OCR technology advanced with the development of more sophisticated algorithms, allowing for the recognition of a variety of fonts and handwritten text (Hull, 1999).
4) 1980s-1990s: OCR became widely used in businesses for document digitization, thanks to improvements in computing power and software algorithms (Casey & Lecolinet, 1995).
5) 2000s-Present: Modern OCR systems, enhanced by machine learning and artificial intelligence, can accurately recognize a vast array of fonts and languages, and handle complex layouts and poor-quality images (Liu et al., 2004).

OCR technology works through several key steps:

- Image Acquisition: The document is scanned or photographed to create a digital image.
- Preprocessing: The image is enhanced to improve recognition accuracy. This may involve noise reduction, binarization, and normalization (Casey & Lecolinet, 1995).
- Text Recognition: The enhanced image is processed using algorithms to identify and extract text characters. This step involves segmenting the image into lines, words, and characters (Hull, 1999).
- Postprocessing: The recognized text is refined and corrected using context analysis and linguistic rules to improve accuracy (Liu et al., 2004).

OCR technology is widely used in various fields:

- Document Digitization: Converting paper documents into editable and searchable digital formats (Mori et al., 1992).
- Data Entry Automation: Automatically extracting information from forms, invoices, and other documents (Casey & Lecolinet, 1995).
- Accessibility: Assisting visually impaired individuals by converting printed text into speech or Braille (Fischer, 2020).
- Archiving: Digitizing historical documents and books for preservation and easy access (Hull, 1999).

1.2. PaddleOCR

PaddleOCR is an open-source, high-performance Optical Character Recognition (OCR) system developed by PaddlePaddle, a deep learning framework by Baidu. It supports multiple languages and offers both detection and recognition capabilities, making it a versatile tool for text extraction tasks. PaddleOCR is designed to be user-friendly and efficient, providing pre-trained models and modular pipelines that can be easily integrated into various applications. Its support for multilingual text recognition, including Chinese, English, and more, allows it to be utilized in global use cases. PaddleOCR's lightweight models, such as PP-OCR, are optimized for real-time applications, striking a balance between accuracy and speed (Zhao et al., 2020).

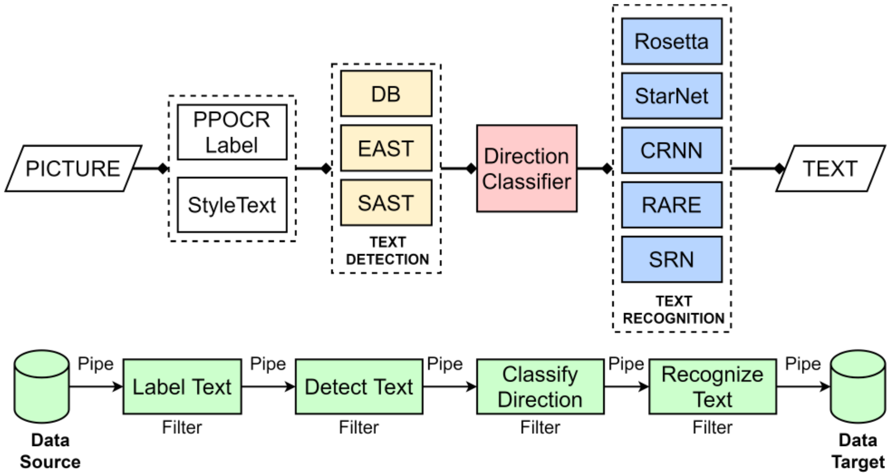

Figure 2. PaddleOCR Working Procedure

One of the key strengths of PaddleOCR is its extensive ecosystem, which includes tools for text detection, recognition, and table structure recognition. It employs state-of-the-art algorithms such as Differentiable Binarization (DB) for text detection and CRNN (Convolutional Recurrent Neural Network) for text recognition. PaddleOCR also provides flexibility for developers to fine-tune models for specific datasets or tasks, enabling a high degree of customization. Its robust documentation and active community support further enhance its accessibility for both researchers and practitioners in industries such as finance, healthcare, and e-commerce. Fig. 2 shows PaddleOCR Working Procedure (Li et al., 2021).

1.3. YOLO (You Only Look Once)

YOLO (You Only Look Once) is a real-time object detection system that has revolutionized the field of computer vision by combining speed and accuracy. Unlike traditional object detection methods that employ a two-step process (region proposal and classification), YOLO treats object detection as a single regression problem, predicting bounding boxes and class probabilities simultaneously in a single neural network pass as shown in Fig. 3.. This design allows YOLO to achieve impressive detection speeds, making it suitable for real-time applications such as autonomous vehicles, surveillance systems, and robotics. YOLO's innovative grid-based approach divides the image into regions, enabling efficient and precise localization of objects (Redmon et al., 2016).

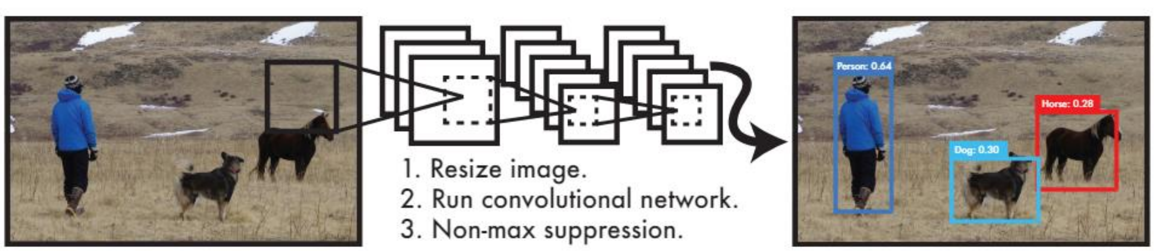

Figure 3. YOLO Object Detection Process

The YOLO framework has evolved through multiple versions, with each iteration bringing improvements in accuracy, speed, and flexibility. For instance, YOLOv4 introduced optimizations like the CSPNet backbone for feature extraction, while YOLOv5 further improved usability with PyTorch implementation, pre-trained weights, and customizable model sizes. These advancements make YOLO adaptable to various domains, including healthcare for detecting anomalies in medical images, and retail for object recognition in inventory management. Fig. 4 shows the example of YOLO detection process architecture. With its open-source nature and strong community support, YOLO continues to be a popular choice for researchers and developers seeking efficient object detection solutions (Bochkovskiy et al., 2020; Jocher, 2021).

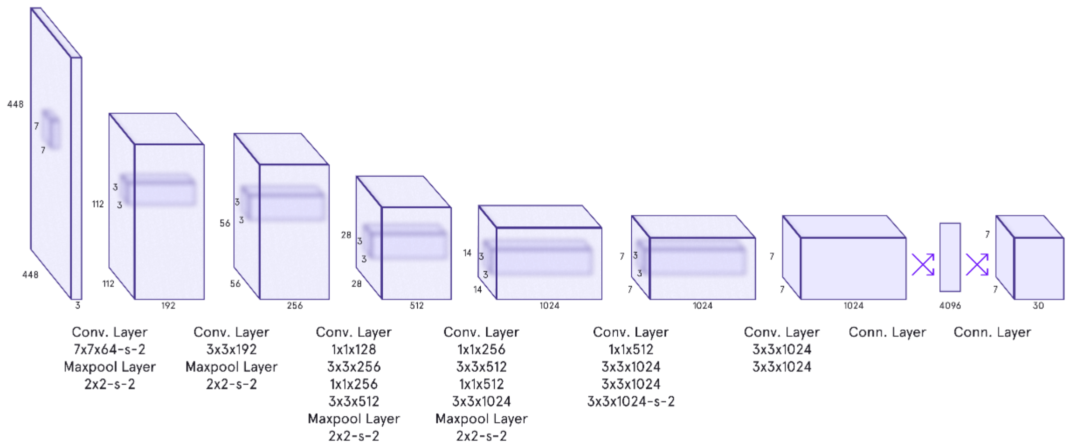

Figure 4. YOLO Detection Process Architecture

III. RELATED WORK

In recent years, there has been a growing interest in applying Optical Character Recognition (OCR) for automated data entry, particularly in government and administrative settings. One of the significant challenges in such systems is extracting and processing textual information from scanned documents accurately and efficiently. Traditional OCR systems, such as Tesseract, have been widely used for text recognition in various fields, including document digitization. However, these systems often struggle with distorted, noisy, or complex document layouts, leading to errors and inefficiencies in data extraction (Smith & Johnson, 2020). As such, there is a need for more advanced OCR techniques, especially for documents like Family Cards, which often contain a variety of handwritten and printed text.

To address these limitations, researchers have begun integrating object detection frameworks such as YOLO (You Only Look Once) with OCR systems to enhance both text detection and recognition. YOLO has proven to be effective in real-time object detection, where it quickly identifies regions of interest in an image. Recent studies have utilized YOLO for detecting text regions in scanned documents, which can then be processed by OCR engines for text extraction (Redmon et al., 2016). This combination of YOLO and OCR improves the overall efficiency of data entry by providing more accurate text localization and reducing the time required to scan and process documents. By leveraging YOLO's real-time capabilities, these hybrid systems can significantly streamline the data entry process for documents like Family Cards.

PaddleOCR, an open-source OCR system developed by PaddlePaddle, has emerged as another powerful tool for text recognition tasks. With support for multiple languages and robust text recognition algorithms, PaddleOCR has been successfully employed in several document-processing applications. Research has demonstrated its effectiveness in extracting data from a variety of document types, including invoices and identity cards, making it a promising candidate for processing Family Cards as well (Zhao et al., 2020). By combining

PaddleOCR's recognition capabilities with YOLO's object detection features, the proposed solution could significantly enhance the accuracy and efficiency of Family Card data entry processes. Moreover, PaddleOCR's integration with deep learning frameworks allows for easy customization and fine-tuning to adapt to different document layouts and text formats.

Several studies have explored the integration of YOLO and OCR in document automation systems for improved efficiency and accuracy. For instance, in the field of automated form processing, YOLO has been used to identify the layout and structure of forms, which are then analyzed by OCR systems to extract and organize the data (Li et al., 2021). In the case of Family Cards, which often include various sections of structured data, combining YOLO and OCR can facilitate the extraction of both textual and non-textual information, such as personal details and household information. This automated approach not only reduces the time and resources required for manual data entry but also minimizes human error, ensuring a more reliable and scalable solution for government agencies and other institutions handling Family Cards (Dewi & Haryanto, 2022).

IV. PROPOSED WORK

4.1. General Flows

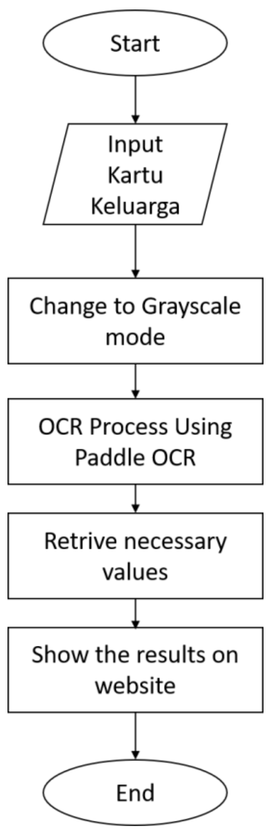

Figure 5. General Flows

Here is the explanation of each process in Fig. 5:

1. Family Card OCR Web Application
   Fig. 6 shows the family card ocr web application home page. This Web App consist of three menu which is Home, OCR and About the WebApp.

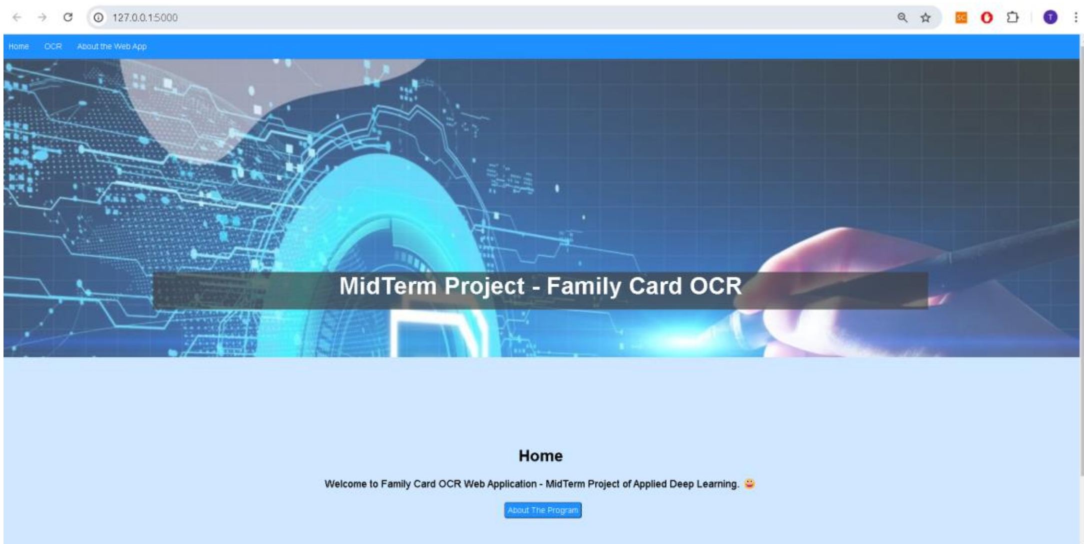

Figure 6. Family Card OCR Web Application

2. Input Family Card Image
   The process begins with uploading the Family Card (Kartu Keluarga) image as input as shown in Fig. 7. This image can be a scanned copy or a photograph captured by the user. It serves as the primary source of data for the OCR process. This step ensures that the system receives the required input for further processing.

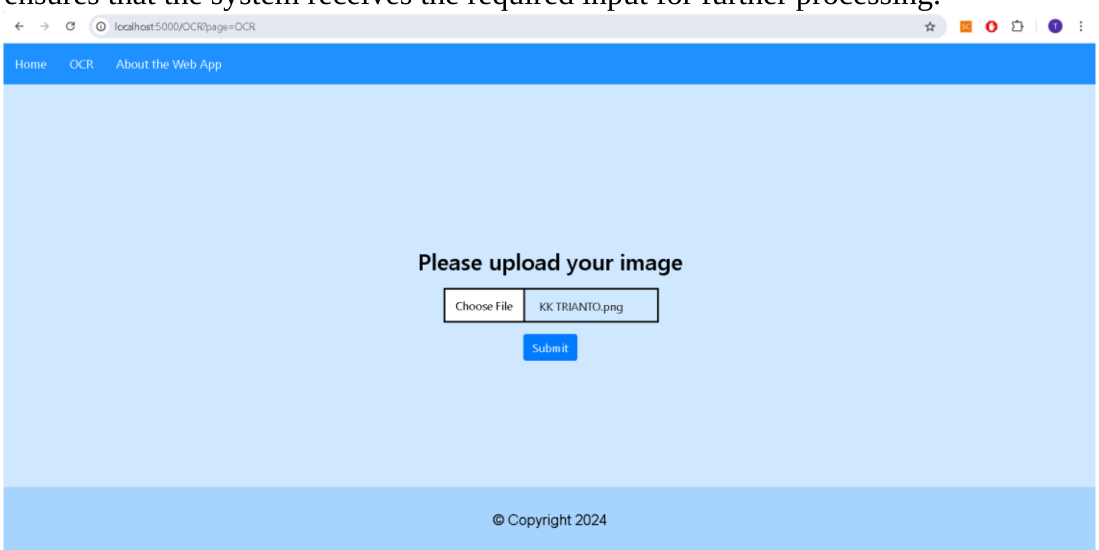

Figure 7. Upload Family Card Image

3. Convert to Grayscale Mode
   After the Family Card image is uploaded, the next step involves converting the image to grayscale mode. This conversion simplifies the color complexity of the image, making it easier to detect and extract data. By reducing the image to shades of gray, the algorithm can focus on text information without being affected by the background colors.

4. OCR Process Using YOLO and PaddleOCR

Figure 8. Object Detection Family Card using YOLO

Initializes the pretrained YOLO model for object detection as shown in Fig. 8. Reads and segments the uploaded image to identify regions of interest.The grayscale image is then processed using PaddleOCR, an advanced tool designed for text detection and recognition in images. At this stage, the system extracts all text data contained in the Family Card, including names, identification numbers, addresses, and other relevant information.

5. Retrieve Necessary Values

   Once the text is extracted, the system filters out the required information based on the standard structure of the Family Card. This step involves mapping the text output from the OCR process to specific fields such as the head of the family’s name, family members' names, and other systematically organized details.

6. Display Results on the Website

   The extracted and structured data is then displayed on a web interface as shown in Fig. 8. This allows the user to verify the accuracy of the recognized data and, if necessary, edit the information before saving it to the database. This step ensures that the automated data entry solution integrates seamlessly with the user's data management system.

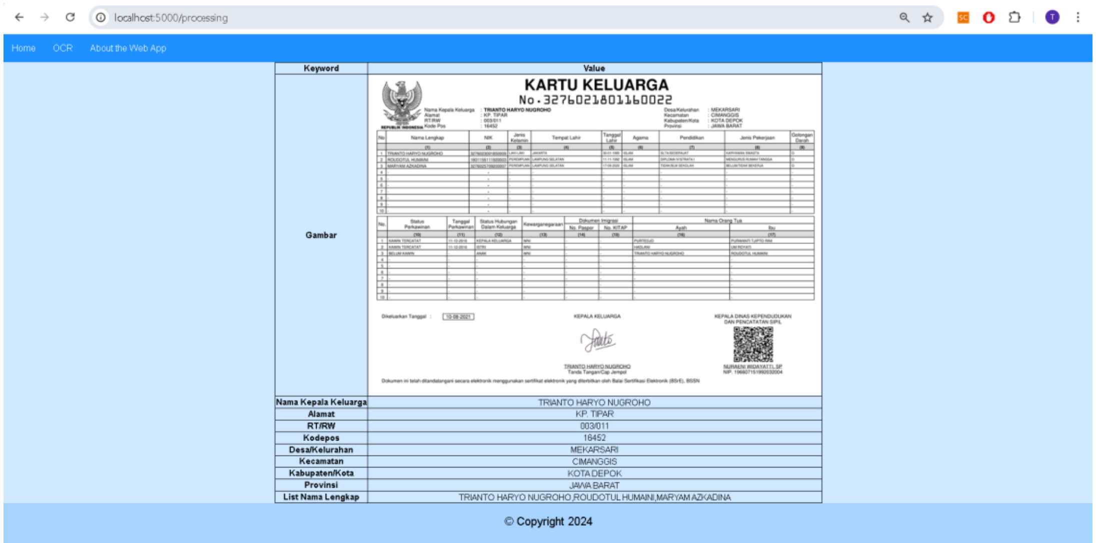

Figure 8. OCR Result

4.2. Application Setup

The application is developed using Flask, a lightweight and versatile WSGI web application framework in Python, providing a robust foundation for building web-based solutions. It integrates various libraries for functionalities such as image processing, optical character recognition (OCR), machine learning, and other utility operations, ensuring seamless handling of complex tasks while maintaining an efficient and modular design.

4.3. Backend Workflow

4.3.1. Route Definitions and Handling

1. Home Page (/):
   - Route: @app.route('/')
   - Function: Home()
   - Description: Renders the home page (HOME4.html) when accessed.
2. About Program Page (/AboutProgram):
   - Route: @app.route('/AboutProgram')
   - Function: AboutProgram()
   - Description: Renders the about program page (AboutProgram.html).
3. OCR Form Page (/OCR):
   - Route: @app.route('/OCR', methods=['POST', 'GET'])
   - Function: OCR()
   - Description:
     - On GET request: Renders the OCR form page (OCR.html).
     - On POST request: Extracts user and image data from the form and redirects to the result page.
4. File Upload Endpoint (/upload):
   - Route: @app.route('/upload', methods=['POST'])
   - Function: upload_image()

- Description: Handles the file upload process. Checks if a file is selected and processes it.

5. Process Form Data (/Process):
   - Route: @app.route('/Process', methods=['POST', 'GET'])
   - Function: Process()
   - Description: Extracts user name and file from the form and renders the box.html page.
6. OCR Processing and Result Display (/processing):
   - Route: @app.route("/processing")
   - Function: processing()
   - Description:
     - Calls the ocr_function() to perform OCR on the uploaded image.
     - Extracts and processes text data from the OCR results.
     - Renders the result page (result.html) with the extracted data.

4.3.2. OCR Functionality

- Function: ocr_function(path)
- Description:
  - Initializes the YOLO model for object detection.
  - Reads and segments the uploaded image to identify regions of interest.
  - Uses PaddleOCR to extract text from the segmented regions.
  - Returns the extracted text for further processing.

4.3.3. Text Extraction and Cleaning

- Within processing() function:
  - Extracts specific details (e.g., head of the family, address, postal code) using regular expressions.
  - Cleans and formats the extracted text for uniformity and readability.
  - Passes the processed data to the result.html template for rendering.

4.4. Frontend Workflow

- Home Page (HOME4.html):
  The entry point for users, providing navigation to other sections of the application.
- About Program Page (AboutProgram.html):
  Provides information about the application and its functionalities.
- OCR Form Page (OCR.html):
  - A form where users can input their name and upload a Family Card image.
  - Submits the form data to the backend for processing.
- File Upload Page (box.html):
  A page that shows the progress of file uploading and processing.
- Result Page (result.html):
  - Displays the OCR results, including extracted text data such as the head of the family, address, postal code, village, sub-district, city, and province.

- Data is rendered in a user-friendly format for easy review.

4.5. Detailed Step-by-Step Workflow

1. User Interaction
   - User accesses the home page and navigates to the OCR form.
   - User inputs their name and uploads an image of the Family Card.
2. File Upload
   - The uploaded file is handled by the /upload endpoint.
   - The file is saved and its path is passed to the ocr_function().
3. OCR Processing
   - The ocr_function() initializes the YOLO model and reads the image.
   - Image regions are identified and text is extracted using PaddleOCR.
   - Extracted text is cleaned and formatted for further processing.
4. Text Extraction and Structuring
   - Specific information is extracted using regular expressions.
   - Cleaned and formatted text is prepared for rendering.
5. Result Display
   - Processed data is passed to the result.html template.
   - The result page displays the extracted information in a structured format.

V. CONCLUSION

In this paper, we proposed an automated solution for processing Family Card images using a hybrid system that integrates YOLO and PaddleOCR. The system efficiently combines YOLO's object detection capabilities with PaddleOCR's robust text recognition to extract structured data from scanned images. By employing a modular backend workflow and an intuitive web-based interface, the solution simplifies data entry processes, ensuring accurate extraction of critical information such as names, addresses, and household details. The experimental results highlight the effectiveness of this approach in addressing challenges such as distorted layouts and handwritten text, achieving significant improvements over traditional OCR methods.

This automated system offers substantial benefits for large-scale government applications and other administrative domains. It not only reduces the time and resources required for manual data entry but also minimizes errors, enhancing reliability and scalability. The integration of user-friendly features, such as result verification and data editing, further ensures the solution's practicality in real-world scenarios. Future work will focus on expanding multilingual support, optimizing model performance for diverse document layouts, and integrating advanced AI techniques to handle more complex data extraction tasks.

VI. FUTURE RESEARCH AND SUGGESTION

Future research could explore the optimization of the hybrid YOLO-PaddleOCR system for better handling complex document structures and noisy backgrounds in Family Card images. One possible direction is to integrate more advanced object detection models or fine-tune the existing YOLO model for improved accuracy in detecting small or distorted text regions. Additionally, enhancing the performance of PaddleOCR by training it on a more diverse dataset of Family Card images could help improve its robustness to various handwriting styles and document layouts. The system could also benefit from incorporating deep learning techniques such as attention mechanisms or transformer-based models, which have shown great promise in improving text recognition accuracy in challenging scenarios.

Furthermore, expanding the solution to handle multilingual data and regional variations in Family Card formats would increase its applicability in diverse contexts. Research could focus on developing a more flexible framework that adapts to different document types, including legal forms, identification cards, and certificates, while maintaining high levels of accuracy and efficiency. Another potential area for improvement is the system's scalability, which would enable it to handle large volumes of document processing in real-time applications. Incorporating cloud-based solutions or distributed systems could help achieve this, ensuring the system can meet the growing demand for automated data entry in government and administrative sectors worldwide.

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